REMARKS

A. Background

Claims 2, 6 and 11 were pending in the application at the time of the Office Action. Claims 2, 6 and 11 were rejected as being obvious over cited art. By this response applicant has not made any amendments to the pending claims. As such, claims 2, 6, and 11 are again presented for the Examiner's consideration in light of the following remarks.

B. Rejection Based on 35 USC 103

Paragraphs 2 and 3 of the Office Action rejects claims 2 and 6 under 35 USC § 103(a) as being obvious over U.S. Patent No. 6,043,940 to Kamiyama et al. *("Kamiyama")* in view of an article by Maciolek et al. *("Maciolek").* Paragraph 4 of the Office Action rejects claim 11 under 35 USC § 103(a) as being obvious over the *Kamiyama / Maciolek* combination in view of U.S. Patent No. 6,559,084 to Fujikawa et al. ("*Fujikawa*"). Applicant respectfully traverses these rejections.

All of the claimed inventions require a cubic crystal material "comprising $KTaO_{3-d}$, where the amount of oxygen deficiency d is $0 \leq d < 10^{-7}$." The Office Action concedes that this limitation is not specifically taught by *Kamiyama* or any of the other references (see Office Action at pp. 2-3). The Office Action asserts, however, that "absent any teaching by Kamiyama or evidence presented by applicant, the formula for $KTaO_3$ taught by Kamiyama is taken to be accurate, with a 'd' value of 0." *id.* That is, the Office Action asserts that the amount of oxygen deficiency (the 'd' value) in the material represented by the chemical formula $KTaO_3$ in Kamiyama is precisely zero. Applicant respectfully submits that this is an incorrect interpretation of Kamiyama.

$KTaO_3$ is a perovskite oxide. Although the subscript for the oxygen molecule is rounded to '3,' it is commonly known in the art that there is at least some oxygen deficiency in these types of

materials unless specifically noted otherwise. The subscript is simply rounded to '3' for simplicity. As such, the mere representation of '$KTaO_3$' by itself does not signify a composition with zero oxygen deficiency.

As discussed in the specification of the present application, a perovskite oxide such as $KTaO_3$ has oxygen deficiency that depends on manufacturing conditions and heat treatment conditions. See Paragraph [0018]. For example as discussed in *Swalin*[1], which is being submitted herewith in an information disclosure statement (IDS), in zinc oxide, an oxide with similar characteristics to $KTaO_3$, the oxide includes a slight oxygen deficiency. See Section 15.5, pp. 305-313. Crystals of such oxides are usually grown at high temperatures. For example, a crystal of $KTaO_3$ is produced by crystal growth at temperatures around 1300°C. Such high temperature means that the thermodynamic contribution of entropy in the system is great, causing oxygen deficiency to occur in a high concentration to maintain an energetically stable condition. The concentration of oxygen deficiency is stable at much lower values at room temperature than those at high temperatures. However, in view of the slow reaction rate at room temperature, it is impossible to have the oxygen deficiency formed at high temperature to be removed completely when returned to room temperature.

Furthermore, as discussed by *Imai and Yagi* [2], which is also being submitted herewith in the IDS, $KTaO_3$ crystals exhibit absorption bands in the near infrared region by O-H bonds. See Section 3.1 on p.730. This signifies that oxygen vacancies are generated in the crystal during the crystal growth, that H_2O molecules enter the crystal afterwards, and that the oxygen vacancies are partly occupied by the oxygen ions together with pairs of hydrogen ions (water molecules). See Section 3.5

---

[1] R.A. Swalin, *Thermodynamics of Solids*, Chapter 15, "Defects in Compounds," John Wiley & Sons, Inc., New York (1962), pp. 272-321.

[2] T. Imai and S. Yagi, *Introducing Protons into Potassium Niobate Single Crystals*, Jpn. J. Appl. Phys. Vol. 38 (1999) pp. 729-736.

on p.734. Thus, when fully grown, $KTaO_3$ crystals contain both real oxygen vacancies which are not occupied and other vacancy sites which are occupied by water molecules.

Fig. 5 of *Imai and Yagi* is a graph showing proton concentration as function of the lithium addition ratio for KTN crystals. The vertical axis of the graph is an amount of integrated absorption, which is proportional to the O-H bond concentration and is used for a probe of the oxygen vacancy concentration. The dashed line in the graph indicates the concentration when annealed in wet Ar, which corresponds to total oxygen vacancy concentrations. The solid line indicates the concentration as grown, which corresponds to the vacancies that are occupied by water molecules. As such, the difference between these two lines indicates the concentration of the real oxygen vacancies. By extrapolating the lines to the y axis, which corresponds to no Li_2O being added, it is obvious that the oxygen vacancy concentrations of the KTN crystals are not zero. That is, the oxygen vacancy concentrations of the KTN crystals are greater than zero when lithium is not added. Although Fig. 5 is directed to KTN, the same effects occur with $KTaO_3$ because the crystallographic structure of $KTaO_3$ is the same as that of KTN.

In conclusion, applicant submits that it is known in the art that $KTaO_3$ does not signify an oxygen deficiency of zero, as shown in two separate references where similar chemical compositions follow this same line of reasoning.

In light of the above, applicant respectfully submits that, contrary to the assertion of the Office Action, neither *Kamihama* nor the other cited references disclose or suggest a cubic crystal material "comprising $KTaO_{3-d}$, where the amount of oxygen deficiency d is $0 \leq d < 10^{-7}$." As such, Applicant submits that a *prima facie* case of obviousness has not been established as the allegedly obvious combinations do not include all of the claim limitations. Accordingly, Applicant respectfully requests that the obviousness rejections with respect to claims 2, 6, and 11 be withdrawn.

No other objections or rejections are set forth in the Office Action.

D. Conclusion

Applicant notes that this response does not discuss every reason why the claims of the present application are distinguished over the cited art. Most notably, applicant submits that many if not all of the dependent claims are independently distinguishable over the cited art. Applicant has merely submitted those arguments which it considers sufficient to clearly distinguish the claims over the cited art.

In view of the foregoing, applicant respectfully requests the Examiner's reconsideration and allowance of claims 2, 6, and 11 as amended and presented herein.

The Commissioner is hereby authorized to charge payment of any of the following fees that may be applicable to this communication, or credit any overpayment, to Deposit Account No. 23-3178: (1) any filing fees required under 37 CFR § 1.16; (2) any patent application and reexamination processing fees under 37 CFR § 1.17; and/or (3) any post issuance fees under 37 CFR § 1.20. In addition, if any additional extension of time is required, which has not otherwise been requested, please consider this a petition therefor and charge any additional fees that may be required to Deposit Account No. 23-3178.

In the event there remains any impediment to allowance of the claims which could be clarified in a telephonic interview, the Examiner is respectfully requested to initiate such an interview with the undersigned.

Dated this 1st day of May 2009.

Respectfully submitted,

/Scott A. Woodbury/ Reg. #55743
SCOTT A. WOODBURY
Registration 55,743

DANA L. TANGREN
Registration No. 37,246

Attorneys for Applicant
Customer No. 022913
Telephone No. 801.533.9800

SAW:cad
2242111_1